

WHAT IS CLAIMED IS:

1. A photosensitive composition comprising:

- (a) 30-70% by weight of an epoxide-containing material;
- (b) 5-35% by weight of an acrylic material selected from aromatic acrylic material, cycloaliphatic acrylic material, or combinations thereof;
- (c) 0-40% by weight of a hydroxyl-containing material;
- (d) at least one cationic photoinitiator; and
- (e) at least one free-radical photoinitiator,

wherein said composition, after exposure to actinic radiation, has:

- (i) an elongation at yield in the range of 7% to no yield;
- (ii) a tensile modulus in the range of 1000 to 1600 N/mm<sup>2</sup>;
- (iii) an average elongation at break of at least 10%; or
- (iv) a yield stress of 28 to 40 kN/mm<sup>2</sup>.

2. The composition of claim 1, wherein the epoxide-containing material is selected from bis(2,3-epoxycyclopentyl)ether, 2,3-epoxy cyclopentyl glycidyl ether, 1,2-bis(2,3-epoxycyclopentyloxy)ethane, bis(4-hydroxycyclohexyl)methane diglycidyl ether, 2,2-bis(4-hydroxycyclohexyl)propane diglycidyl ether, diglycidyl ether of neopentyl glycol, 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane, 3,4-epoxy-6-methylcyclohexylmethyl-3,4-epoxy-6-methylcyclohexanecarboxylate, di(3,4-

epoxycyclohexylmethyl)hexanedioate, di(3,4-epoxy-6-methylcyclohexylmethyl)hexanedioate, ethylenebis(3,4-epoxycyclohexanecarboxylate), ethanedioldi(3,4-epoxycyclohexylmethyl)ether, vinylcyclohexene dioxide,  
5 dicyclopentadiene diepoxide, 1,2-epoxytetradecane, a di(oxiranyl) poly(oxy-1,4-butanediyl), a partially acrylated bisphenol A epoxy, and 2-(3,4-epoxycyclohexyl-5,5-spiro-3,4-epoxy)cyclohexane-1,3-dioxane, and combinations thereof.

10 3. The composition of claim 1, wherein the acrylic material is selected from 1,4-dihydroxymethyl-cyclohexane diacrylate, bisphenol A diacrylate, trimethylolpropane triacrylate, and ethoxylated bisphenol A diacrylate and combinations thereof.

15 4. The composition of claim 1, wherein the hydroxyl-containing material is selected from 1,4-cyclohexanedimethanol, aliphatic and cycloaliphatic mono hydroxy alkanols, an aliphatic polycarbonate diol, and linear  
20 and branched polytetrahydrofuran polyether polyols, and combinations thereof.

25 5. The composition of claim 1, wherein the free-radical photoinitiator is a 1-hydroxyphenyl ketone.

30 6. The composition of claim 1, wherein the free-radical photoinitiator is selected from an alpha-hydroxyphenyl ketone, benzil dimethyl ketal or 2,4,6-trimethylbenzoyldiphenylphosphine oxide.

7. The composition of claim 1, wherein the composition comprises 32-48% by weight of an epoxide-containing material.

8. The composition of claim 1, wherein the composition comprises 10-20% by weight of an acrylic material selected from aromatic acrylic material, cycloaliphatic acrylic material, or combinations thereof.

9. The composition of claim 1, wherein the composition comprises 10-39% by weight of a hydroxyl-containing material.

10 10. The composition of claim 1, wherein the composition comprises 35-69.9% by weight of an epoxide-containing material, 10-20% by weight of an acrylic material selected from aromatic acrylic material, cycloaliphatic acrylic material, or combinations thereof, and 10-39% by weight of a hydroxyl-containing material.

11. The composition of claim 10, wherein the epoxide-containing material includes 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, 1,2-epoxytetradecane, diglycidyl ether of neopentyl glycol, or  $\alpha$ -(oxiranylmethyl)- $\omega$ -(oxiranylmethoxy) poly(oxy-1,4-butanediyl), or combinations thereof.

12. The composition of claim 1, wherein the hydroxyl-containing material includes a polytetrahydrofuran polyol, 1,4-cyclohexanedimethanol, or an aliphatic polycarbonate diol, or combinations thereof.

13. A three-dimensional article formed from a photosensitive composition comprising:

- (a) 30-70% by weight of an epoxide-containing material;

- (b) 5-35% by weight of an acrylic material selected from aromatic acrylic material, cycloaliphatic acrylic material, or combinations thereof;
- 5 (c) 0-40% by weight of a hydroxyl-containing material;
- (d) at least one cationic photoinitiator; and
- (e) at least one free-radical photoinitiator,

wherein the article has:

- 10 (i) an elongation at yield in the range of 7% to no yield;
- (ii) a tensile modulus in the range of 1000 to 1600 N/mm<sup>2</sup>;
- 15 (iii) an average elongation at break of at least 10%; or
- (iv) a yield stress of 28 to 40 kN/mm<sup>2</sup>.

20 14. The article of claim 13, wherein the composition comprises 35-69.9% by weight of an epoxide-containing material, 10-20% by weight of an acrylic material selected from aromatic acrylic material, cycloaliphatic acrylic material, or combinations thereof, and 10-39% by weight of a hydroxyl-containing material.

25 15. The article of claim 13, wherein the epoxide-containing material includes 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, 1,2-epoxytetradecane, diglycidyl ether of neopentyl glycol, or  $\alpha$ -(oxiranylmethyl)- $\omega$ -(oxiranylmethoxy) poly(oxy-1,4-butanediyl), or combinations

30 thereof.

16. The article of claim 13, wherein the hydroxyl-containing material includes a polytetrahydrofuran polyol, 1,4-cyclohexanedimethanol, or an aliphatic polycarbonate diol, or combinations thereof.

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17. A process for forming a three-dimensional article comprising:

- (1) coating a layer of a composition onto a surface, the composition comprising:
  - (a) 30-70% by weight of an epoxide-containing material;
  - (b) 5-35% by weight of an acrylic material selected from aromatic acrylic material, cycloaliphatic acrylic material, or combinations thereof;
  - (c) 0-40% by weight of a hydroxyl-containing material;
  - (d) at least one cationic photoinitiator; and
  - (e) at least one free-radical photoinitiator,
- (2) exposing the layer imagewise to actinic radiation to form an imaged cross-section, wherein the radiation is of sufficient intensity to cause substantial curing of the layer in the exposed areas;
- (3) coating a layer of the composition onto the previously exposed imaged cross-section;
- (4) exposing said thin layer from step (3) imagewise to actinic radiation to form an additional imaged cross-section, wherein the radiation is of sufficient intensity to cause substantial curing of the thin layer in the

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exposed areas and to cause adhesion to the previously exposed imaged cross-section;

- (5) repeating steps (3) and (4) a sufficient number of times in order to build up the three-dimensional article,

wherein the article has:

- (i) an elongation at yield in the range of 7% to no yield;
- (ii) a tensile modulus in the range of 1000 to 1600 N/mm<sup>2</sup>;
- (iii) an average elongation at break of at least 10%; or
- (iv) a yield stress of 28 to 40 kN/mm<sup>2</sup>.

18. The process of claim 17, wherein the actinic radiation is in the range of 280-650 nm.

19. The process of claim 17 wherein the exposure energy is in the range of 10-150 mJ/cm.

20. The process of claim 17, wherein the epoxide-containing material includes 3,4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, 1,2-epoxytetradecane, diglycidyl ether of neopentyl glycol, or  $\alpha$ -(oxiranylmethyl)- $\omega$ -(oxiranylmethoxy) poly(oxy-1,4-butanediyl), or combinations thereof and the hydroxyl-containing material includes a polytetrahydrofuran polyol, 1,4-cyclohexanedimethanol, or an aliphatic polycarbonate diol, or combinations thereof.